V Circular Polarizer: First Tests at U5UA

I Baek, E Vescovo (NSLS)

Abstract No. Baek9882
Beamline(s): **U5UA**

Introduction: For magnetic material studies, circularly polarized light can provide more diverse and direct means to probe electronic spin states by selectively exciting each spin state. Especially in the UV energy range, the combination of intense undulator linear light with a circular polarizer is one of the easiest ways to acquire high quality circular polarized light since the efficiency of the circular polarizer becomes higher as the photon energy gets lower. A quadruple reflection UV circular polarizer [1] has been installed to extend the capability of the spin-resolved photoemission program at the U5UA beamline. The circular polarizer was tested to investigate beam polarization and intensity changes at varying angle values of the circular polarizer.

Methods and Materials: A 45°-incidence Au mirror and a photodiode detector were used to analyze the beam polarization. Since the reflectivity of the 45°-incidence Au mirror for S-polarized light is much higher than for P-polarized light, we can selectively measure the intensity of the S-polarization component with this mirror. We scanned the intensity of the beam from the circular polarizer by rotating the mirror around the beam axis. If there is no unpolarized light from source, the intensity of pure circular polarized light detected at the photodiode becomes independent of mirror rotation. The testing setup is shown in Figure 1. Also these measured circular conditions were compared with numerical calculations based on optical parameters of Au.

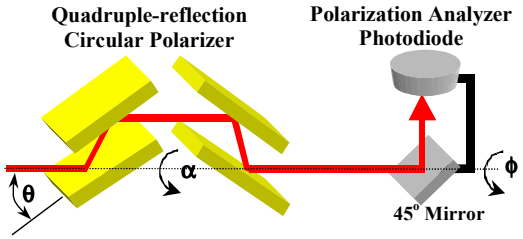

Figure 1. Schematic drawing of the quadruple

Results: The *α* and *θ* angle condition for pure circular polarization is acquired at various photon energies between 20 and 70 eV. In Figure 2, the measured *θ* values were around 2 degrees higher than the calculated values, which resulted in decreased polarizer transmission. Also measured *α* values looked different from the expected values above 35eV. This difference is supposed to be from higher order harmonics contributions, which are ingnored in the calculation. Intensity change with *Φ* angle rotation near the circular polarization condition is shown in Figure 3. As *α* or *θ* angle changes from purely circular condition, linearly polarized light starts showing up. As is expected in our calculation, the intensity is more sensitive to *θ* angle change, while phase change is dependent on both *α* and *θ* angle.

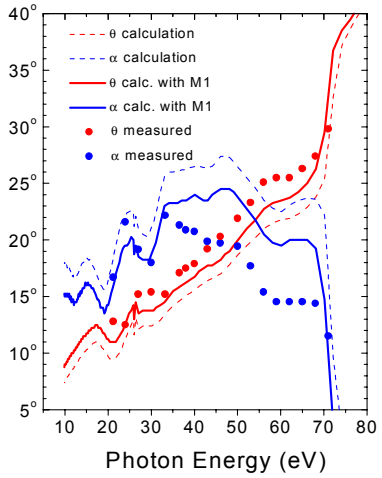

Figure 2. α, θ angle condition for pure circular polarized light as function of photon energy.

Conclusions: A quadruple reflection UV circular polarizer has been installed and tested at the U5UA beamline. The polarizer condition for pure circular polarization is acquired in 20-70 eV photon energy range. The trend of this result is consistent with theoretical calculation, but absolute value differences are observed.

References: [1] H. Höchst, R. Patel, F. Middleton, Nucl. Instr. and Meth. A **347**, 107 (1994)

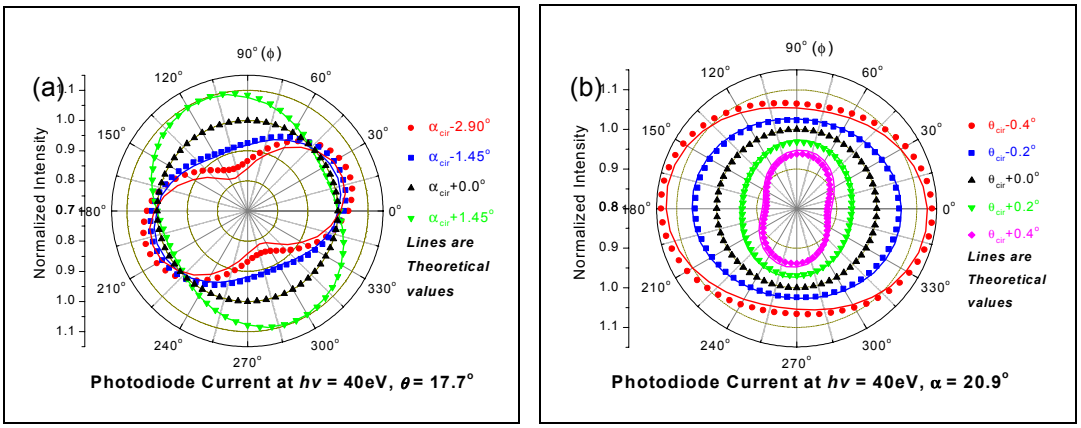

Figure 3. Measured and theoretical(continuous curves) beam intensities as function of analyzer angle(*Φ*) close to the optimum $(\alpha, \theta)^{cir}$ condition. (a) fixed *α*-angle and (b) fixed *θ*-angle.